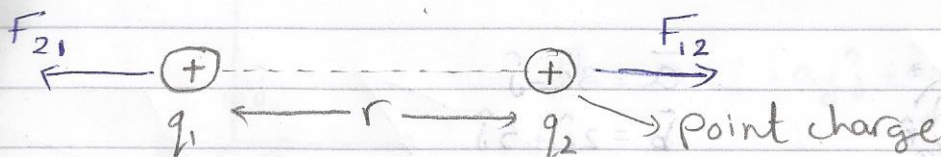


28-2-2013

Electricity

Coulomb's law



$F_{12} \Rightarrow$ Force by charge 1 on 2

$F_{21} \Rightarrow$ Force by charge 2 on 1

$$|F_{12}| = |F_{21}| = F$$

$$F \propto \frac{|q_1| |q_2|}{r^2}$$

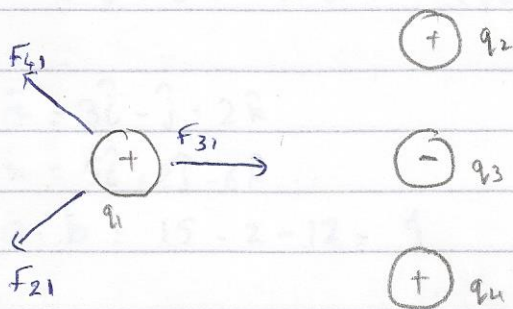
$$F = k \frac{|q_1| |q_2|}{r^2}$$

$k = 9 \times 10^9$ in vacuum

$$k = \frac{1}{4\pi\epsilon_0}, \quad \epsilon_0 = \frac{1}{4\pi k} = 8.85 \times 10^{-12}$$

$\epsilon_0 \Rightarrow$ Permittivity of vacuum

* For n point charges:



$$\text{Net force on } q_1 (F_1) = \vec{F}_{21} + \vec{F}_{31} + \vec{F}_{41}$$

3) Find resultant force on q_3

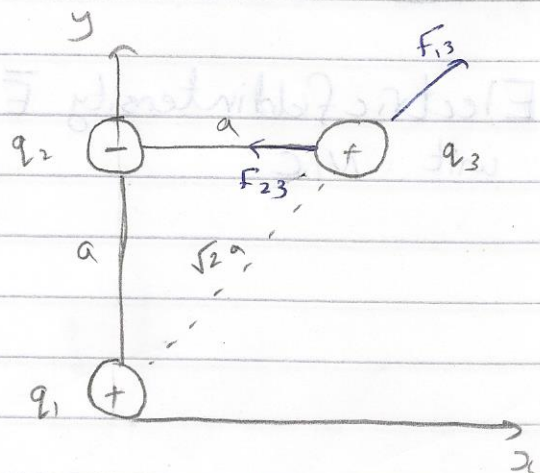
$$q_1 = q_3 = 5 \mu C, \quad q_2 = -2 \mu C$$

$$a = 0.1 \text{ m}$$

$$|F_{23}| = k \frac{|q_2| |q_3|}{r_{23}^2} = \frac{9 \times 10^9 \times (2 \times 10^{-6}) \times (5 \times 10^{-6})}{0.1^2}$$

$$= 9 \text{ N}$$

$$\vec{F}_{23} = -9 \hat{i} \text{ N}$$



$$|F_{13}| = k \frac{|q_1| |q_3|}{r_{13}^2} = \frac{9 \times 10^9 \times (5 \times 10^{-6})^2}{(0.1\sqrt{2})^2} = 11 \text{ N}$$

$$\vec{F}_{13} = 11 (\cos \theta \hat{i} + \sin \theta \hat{j}) \text{ N}$$

$$\theta = 45^\circ$$

$$\vec{F}_{13} = 7.9 \hat{i} + 7.9 \hat{j} \text{ N}$$

$$\vec{F}_3 = \vec{F}_{13} + \vec{F}_{23} = 7.9 \hat{i} + 7.9 \hat{j} - 9 \hat{i} = -1.1 \hat{i} + 7.9 \hat{j} \text{ N}$$

4) Find the position of q_3 such that $F_3 = 0$

$$F_{13} = k \frac{q_1 q_3}{r^2} = \frac{9 \times 10^9 \times 15 \times 10^{-6} \times q_3}{\left(\frac{x-2}{2-x}\right)^2}$$

$$F_{23} = k \frac{q_2 q_3}{r^2} = \frac{9 \times 10^9 \times 6 \times 10^{-6} \times q_3}{x^2}$$

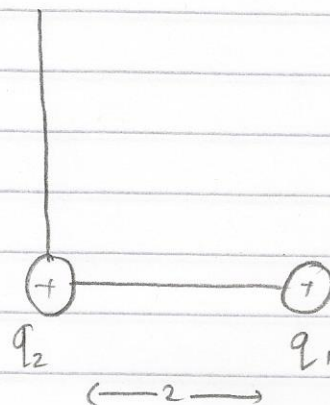
$$F_{13} = F_{23}, \quad \frac{9 \times 10^9 \times 15 \times 10^{-6} \times q_3}{\left(\frac{x-2}{2-x}\right)^2} = \frac{9 \times 10^9 \times 6 \times 10^{-6} \times q_3}{x^2}$$

$$\frac{15 \times 10^{-6}}{\left(\frac{x-2}{2-x}\right)^2} = \frac{6 \times 10^{-6}}{x^2}$$

$$\frac{6}{15} = \frac{x^2}{\left(\frac{x-2}{2-x}\right)^2}$$

$$\sqrt{\frac{6}{15}} = \frac{x}{2-x}$$

$$x = 0.775 \text{ m}$$



$$q_1 = 15 \mu C$$

$$q_2 = 6 \mu C$$

Electric fields

Electric field intensity $\vec{E} = \frac{\vec{F}}{q}$

unit: N/C

